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Grass Biomass Dynamics: Exploring Altitudinal Variations in Daksum Forest Range, Kashmir

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ABSTRACT: Three elevations Arishan, Harkani, and Deesu were chosen for the study based on altitudinal variations in the Daksum range of the Anantnag Forest Division in Kashmir during the year 2023–24. Three 0.1-hectare transects were chosen for biomass estimation at each of the three locations based on altitude. Additionally, soil samples and samples of leading grass species were gathered for nutrient analysis. The grasses' biomass content varied from 18.50 q/ha to 35.15 q/ha, with lower altitude (Deesu) exhibiting the highest biomass content at 35.15 q/ha due to less biotic interference, followed by intermediate site at 27.98 q/ha, and upper altitude (Arishan) exhibiting the lowest biomass content at 18.15 q/ha with maximum grazing intensity.

Keywords: Biomass, Daksum, Arishan, Harkani, Deesu, migratory, soil, grazing.

INTROUCTION

With an estimated area of 52.5 million square kilometres, or roughly 40.5% of the total terrestrial area excluding Greenland and Antarctica, grasslands, which include savannah, shrub steppe, and other types of natural vegetation, are among the largest ecosystems in the world and could cover 33 million square kilometres of the earth's land surface (White *et al.*, 2000, Ahmed & Sharma 2014). Grasslands are a vital resource that supports the lives of about one billion people worldwide. Additionally, they offer a wide range of services that improve human existence. Grasslands are important for maintaining biodiversity, sequestering carbon, maintaining clean surface and ground waters, and creating a desirable setting for leisure and recreation in addition to producing herbage for animals (Gintzburger, 1986; Sudhansu *et al.*, 2021).

The Kashmir Valley has only very limited flat agricultural land that requires extensive irrigation. Grasslands in such areas hold a significant potential for fodder production with relatively lesser investment. The agriculture in this region is further restricted by a long and harsh winter, so the farming can be done only for a short summer season of 4-5 months. Moreover, land holdings in the valley are small, and biomass availability is very limited (Bawa, 1986; Manjula, *et al*., 2024).

In the studies of phytosociology and phyto-mass, it is very important for knowing the structural composition of the vegetation under specific environmental conditions. Forage biomass in scrubby ecosystems, a critical resource for animal production. However, heavy grazing resulted in significant depletion of rangelands worldwide. Above ground biomass in grasses is utility-wise important for sustaining the livestock (World Resources 2000-2001).

Healthy soil is significant in supporting vegetation growth, releasing oxygen, retaining water, reducing storm run-off, breaking down waste, and serving as a primary component in the food chain (Marx *et al.*, 1999; Rodriguez-Iturbe, 2000, Brown, *et al.*, 1989). In forest ecosystems, edaphic factors (soil-related properties) influence species distribution, their ecological roles, and productivity. Soil structure, composition, and nutrient content are vital for forest regeneration and succession dynamics (Rozhkov & Karpachevskii 2006, Romika *et al*., 2024; Dar, *et al*., 2011).

The present study aims to provide valuable data on above-ground biomass production. With these considerations, the study titled "Grass Biomass Dynamics: Exploring Altitudinal Variations in Daksum Forest Range, Kashmir." was undertaken to achieve the following objectives.

— To determine the above ground biomass production of grasses.

Study area. The Anantnag Forest Division and covers an area of 798.64 Square Kilometers. The forests of Anantnag Forest Division spread over a vast tract and are situated between 33°21' 56.63" N to 33°50' 92" North Latitude and 75°40'4.60" E to 75°32' 6.59" East Longitude. The entire area exists covered by G.T. Sheet Nos., 430/1, 0/2, 0/3, 0/5, 0/6, 0/7, 0/10. Occupying the

south-eastern portion of Kashmir Valley, the tract chiefly lies in Anantnag District of Kashmir Province. It is bounded on the east and the south by the lofty PirPanjal mountain Range, separating it from Ramban and Kishtwar Forest Divisions. The Mattan Range of Lidder Forest Division marks the boundary of the Division on the western side.

Proposed study was carried out along three locations of the Daksum range spread over an area of 34418.73 ha. This forest range is situated between 33°36′ 43" N North Latitude and 75° 26′ 6" E East longitude.

MATERIAL AND METHODS

The present study entitled Determination of biomass production of grasslands in Daksum range of Anantnag Forest division of Kashmir" was carried out at three sites/altitudes in Daksum range of Anantnag Forest division Kashmir. The details of the experimental sites, materials used and methodology adopted for this study are as under.

The sample site selection was done as follows:

Sample sites	Altitude
Arishan	12600 ft above mean sea level
Harkani	9800 ft above mean sea level
Deesu	7700 ft above mean sea level

Above ground biomass was determined by clipping the above ground living matter of all the species from quadrates of 1m × 1m size. The grass samples were harvested at ground level, washed properly and were sorted out species wise and stored in different paper bags. They were dried in oven at 70-75°C for 48 hours and after attaining constant weight, each sample was weighed for determining species wise biomass recorded.

Above ground biomass production of grasses. The data tabulated in Table 1 shows the total above ground biomass (q/ha) production of different grass species during the study period for Upper (Arishan), Middle (Harkani) and Lower (Deesu) altitudes of Daksum Range of Anantnag Forest Division of Kashmir.

Biomass production of different grass species in upper altitude (Arishan). The data tabulated in Table 1 pertaining to higher altitude (Arishan) of Daksum range of Anantnag forest division gives the biomass production of different grass species. The total above ground biomass production of grasses at higher altitude ranged from 1.49 to 3.95 q/ha. A perusal of data explicated that the total above ground biomass in higher altitude was 18.52 q/ha with the species *Poa pretense* (3.95 q/ha) contributing to the maximum biomass production followed by *Cynodon dactylon* (2.70 q/ha), *Hypercium perforatum* (2.70 q/ha), *Poaannua* (2.58 q/ha), *Potentilla nepalensis* (1.86 q/ha). The least biomass content was recorded in *Gypsophilla cerastoides* (1.85 q/ha), *Rumex neplensis* (1.63 q/ha), and *Agrostis canina* (1.49 q/ha).

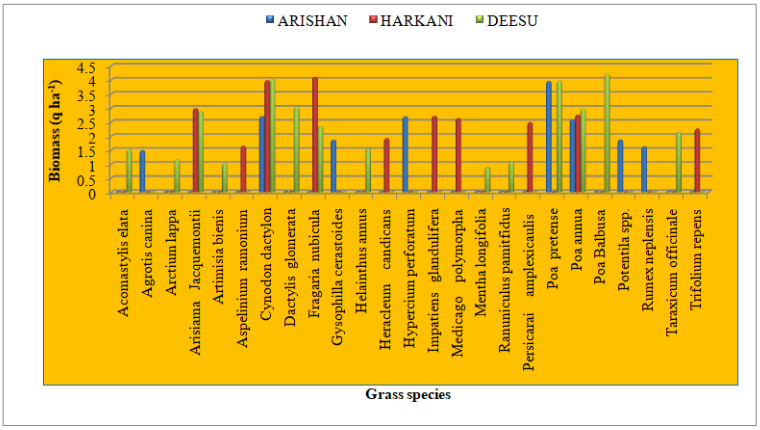
Biomass production of different grass species in middle altitude (Karkani). The data tabulated in Table 1 pertaining to middle altitude (Harkani) envisages that the total above ground biomass production at middle altitude ranged from 1.65q/ha to 4.10 q/ha. A perusal of data explicated that the total above ground biomass in middle elevation was 27.98 q/ha with the species *Fragaria nubicula* (4.10 q/ha) contributing maximum biomass production followed by *Cynodon dactylon* (3.98 q/ha), *Arisieama jacquemontii* (2.98q/ha), *Poaannua*(2.95 q/ha), *Impatiens glandulifera* (2.71 q/ha), *Medicago polymorpha* (2.63 q/ha), *Persicaria amplexicaulis* (2.49q/ha), *Trifolium repens* (2.26q/ha). The least contribution was of *Heracleum candicans* (1.92 q/ha) and *Asplenium ramosum* (1.65 q/ha).

Biomass production of different grass species in lower altitude (Deesu). The data tabulated in Table 1 pertaining to Lower altitude (Deesu) of Daksum range of Anantnag Forest division shows the above ground biomass production of different grass species. The total above ground biomass production at lower elevation ranged from 0.90 q/ha to 4.21 q/ha. A perusal of data explicated that the total above ground biomass in lower altitude was 35.15 q/ha with the species *Cynodon dactylon* (4.01 q/ha) contributing maximum biomass production followed by *Poa balbusa* (4.21 q/ha), *Poa pretense* (3.22 q/ha), *Dactylis glomerata* (3.01 q/ha), *Poaannua* (2.95 q/ha), *Arisieama jacquemontii* (2.87 q/ha), *Fragaria nubicula* (2.35q/ha), *Taraxicum officinale* (2.14q/ha), *Rumex patentia* (1.74 q/ha), *Persicaria amplexicaulis* (1.63 q/ha), *Helainthus annus* (1.56 q/ha), *Acomastylis elata* (1.51 q/ha).The least contribution was of *Arctium lappa* (1.16 q/ha), *Artemesia sp.* (1.04 q/ha), *Ranuniculus pamitfidus* (1.08 q/ha) and *Mentha longifolia* (0.90 q/ha).

Table 1: Above ground biomass (q/ha) of different grass species at three sites in Daksum range Anantnag Forest Division.

Species name	Sites		
	Arishan	Harkani	Deesu
Acomastylis elata	—	—	1.51
Agrotis canina	1.49	—	—
Arctium lappa	—	—	1.16
Arisiama jacquemontii	—	2.98	2.87
Artemisia sp	—	—	1.04
Aspelinium ramosum	—	1.65	—
Cynodon dactylon	2.70	3.98	4.01
Dactylis glomerata	—	—	3.01
Fragaria nubicula	—	4.10	2.35
Gysophilla cerastoides	1.86	—	—
Helainthus annus	—	—	1.56

Heracleum candicans	—	1.92	—
Hypercium perforatum	2.70	—	—
Impatiens glandulifera	—	2.71	—
Medicago polymorpha	—	2.63	—
Mentha longifolia	—	—	0.90
Ranuniculus pamitfidus	—	—	1.08
Persicarai amplexicaulis	—	2.49	1.63
Poa pretense	3.95	—	3.22
Poa annua	2.58	2.75	2.95
Poa balbusa	—	—	4.21
Potentila spp.	1.86	—	—
Rumex neplensis	1.63	—	1.74
Rumex patentia	—	—	1.74
Taraxicum officinale	—	—	2.14
Trifolium repens	—	2.26	—
Total/ S.E.	**18.50/±1.11**	**27.98/±0.29**	**35.15/±0.23**



Above ground biomass (q ha^{-1}) of different grass species at three different elevations.

DISCUSSION

Above ground biomass production of grasses. The area encompassing Daksum range of Anantnag forest division is sparsely populated by human beings at higher altitudes but is in close proximity with few villages having a fairly rich livestock population, owned by Gujjars and Bakerwals living within the forest. During the present study, the highest value of biomass was recorded at Protected site (Deesu) followed by (Harkani) and the least at Grazed site (Arishan) (Table 1). An insight of the data showed that the above ground biomass varied between a minimum of 18.55 q/ha at higher elevation site to a maximum of 35.15 q/ha at lower altitude site. It was observed that total biomass showed a general trend increasing towards the summer season. Being protected, the above ground biomass showed luxuriant growth at Lower site (Deesu) in the summer season. Plant biomass is an important measure of ecosystem functioning. The magnitude of impact that livestock grazing may have on a plant community is dependent upon intensity of grazing. Also, as our results indicate, aboveground biomass decreased under heavy grazing intensity. These views are supported by Wang *et al.* (2022); Gao *et al.* (2007); Ramswaroop *et al.* (2022). The results are also supported by those of the Lone and Pandit (2007) while studying the impact of grazing on various community features and biomass of herbaceous species in Langate Forest division of Kashmir, during the year 2002-2003. The grazed areas showed low biomass values as compared to the protected ones for all the seasons. The plant biomass for protected areas was maximum in summer (1221 g/m^2) and minimum in winter (290.62 g/m^2) as against grazed areas having maximum value 590.81 g/m^2 autumn and minimum 183.75 g/m^2 in winter.

CONCLUSIONS

In the present study the total above ground biomass of grass vegetation varies in grazing and non-grazing sites respectively. The biomass values of grasses were higher in non-grazing sites (Deesu) in comparison to extensive grazing site (Arishan). An insight of the data showed that the above ground biomass varied between a minimum of 18.50 q/ha (ARISHAN) to a maximum of 35.15 q/ha (Deesu). The data related to biomass evinces that the total above ground biomass in lower elevation was 35.15 q/ha with the species *Poa balbusa* (4.21 q/ha) contributing maximum biomass production. The total above ground biomass production at middle altitude ranged from 1.65 to 4.10 q/ha. Further aboveground biomass at middle elevation was (27.98 q/ha) with the species *Fragaria nubicula* (04.10 q/ha) contributing to the maximum biomass production. Further at upper altitude the biomass content ranged from 1.49 to 3.95 q/ha with a total biomass content of 18.50 q/ha, *Poa pretense* (3.95 q/ha) contributing to the maximum biomass production.

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